

## **Appendix 6: Estimated Acres of Soil Disturbance and Net Soil Productivity Loss**

Forest soil productivity may be defined as the capacity of a soil to sustain plant growth. Currently there is limited data available quantifying the long-term effects on soil productivity from forest management activities. Quantifying the effects of soil disturbance on long-term soil productivity is difficult because of its variability and complexity. It is dependent on various interacting facts such as climate, soil properties, organic matter, living organisms, topography and management practices. Long-term soil productivity (LTSP), focusing mainly upon organic matter and compaction, is currently being conducted by the BLM, Forest Service, and major universities and government worldwide. There has been no study completed for an entire rotation. Most research studies have reported reductions in height and diameter growth of generally 5 to 50% on conifer species with increasing compaction or bulk density. But the results have been mixed. Recently several researchers have found some short-term (less than 10 years) reductions but no long-term reductions in tree growth with increasing bulk density. Favorable soil and climate conditions may potentially compensate some of adverse effects of soil compaction and disturbance.

The following assumptions were used to predict soil productivity losses for this project.

1. Existing roads, skid trails and landings would be used as much as practically possible.
2. Ground disturbance from designated skid trails and landings would be limited to less than 10 percent in each timber harvest unit. (This estimate assumes an average skid trail width of about 12 feet and an average spacing of 150 feet.)
3. Implementing appropriate design features and BMPS would result in mostly light to moderate soil compaction on skid trails and cable yarding corridors and little top soil displacement.
4. Operating ground-based equipment would result in a loss of soil productivity of about 30% from compacted surfaces (skid trails & landings). This estimate is based on an unpublished, 1981 MS on file at the BLM Salem District Office titled "Impacts of Subsoiling on Soil Compaction" by William E. Power. The study compared measured volume difference on 50 to 60 year old Douglas fir on severely compacted landings and railroad beds compared to undisturbed areas. Assuming that the project design features and appropriate BMPs are fully implemented, it is expected that most of the compaction on skid trails would be light to moderate and little top soil lost. Losses in productivity for this project are likely to be less 30% due lower compaction level expected and more favorable soil and climate conditions than the research study area.
5. All skid trails and landings associated within regeneration units that are used would be ripped with properly designed equipment with proper technique. Ripping would break up the compacted soil and restore most of the physical soil. Several studies have reported with subsoiling skid trails restoring at least 50% of the long-term productivity lost from soil

compaction. Areas to be commercial thinned by ground-based yarding would not be subsoiled because treatment would be difficult and ineffective due to the large (wide) ripping equipment required and the nature of the skid trails. These areas would be ripped after final harvest.

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6. Cable yarding would create a narrow (less 4 feet wide) trail resulting in about 2 to 4 percent areal light to moderate compaction and displacement, resulting in productivity loss of about 1 percent.

7. Average road disturbance width = 23 feet.

8. Average road compaction width = 16.1 feet

9. Subsoiling natural surface roads would mitigate 50 percent of the negative effects of soil compaction. Little improvement in soil productivity is expected from subsoiling rocked or gravel roads. It is estimated that half of the roads proposed for additional decommissioning are natural surfaced.

### Estimated Soil Disturbance and Net Loss in Soil Productivity

**Table 1: Alternative 2: Estimated Soil Disturbance**

Timber Sale Unit	Unit Area (Acres)	Soil Disturbance from Timber Harvest Activities (Acres)				Soil Disturbance from Road Construction and Decommissioning (Acres)				Total Disturbance (Acres)
		Ground-based Com. Thin	Ground-based Regen.	Cable Yarding Com. Thin	Cable Yarding Regen.	New Perm. Road	Temp. Road (semi-perm)	Road Reconstruction	Additional Road Decom.	
3-1, 3-2, 3-3	121.6	1.8	9.5	0.0	0.3	0.0	0.5	1.6	1.7	15.4
7-1	50.6	2.0	0.0	0.6	0.0	1.6	0.0	0.0	0.0	4.2
9-1	13.1	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	1.3
15-1	58.9	2.0	3.9	0.0	0.0	0.0	0.7	0.0	0.5	7.1
17-1	19.4	1.9	0.0	0.0	0.0	0.0	0.0	0.3	0.0	2.2
21-1	76.1	0.0	4.1	0.7	0.0	0.0	1.1	0.0	0.0	5.9
21-2, 21-3	43.3	0.0	4.3	0.0	0.0	0.0	0.2	0.0	0.0	4.5
27-1	108.9	3.8	0.0	1.3	0.2	1.8	0.0	0.0	0.0	7.1
29-1	26.6	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.2	0.7
33-1	14.5	0.0	1.4	0.0	0.0	0.0	0.0	0.4	0.0	1.8
Total LL	533.0	11.5	24.5	3.1	0.5	3.4	2.5	2.3	2.4	50.2

**Table 2: Alternative 2: Estimated Loss in Soil Productivity**

Timber Sale Unit	Loss in Soil Productivity (Acres)						Increase in Soil Productivity (Acres)	Net Loss in Soil Productivity
	Ground-based Com. Thin	Ground-based Regen.	Cable Yard. Com. Thin	Cable Yard. Regen.	New Perm. Road	Temp. Road (semi-perm)	Decom. Reconst & Addit. Road	
3-1, 3-2, 3-3	-0.5	-1.4	0.0	-0.1	0.0	-0.7	0.7	-2.0
7-1	-0.6	0.0	-0.3	0.0	-1.1	0.0	0.0	-2.0
9-1	0.0	-0.2	0.0	0.0	0.0	0.0	0.0	-0.2
15-1	-0.6	-0.6	0.0	0.0	0.0	-0.3	0.2	-1.4
17-1	-0.6	0.0	0.0	0.0	0.0	-0.1	0.1	-0.6
21-1	0.0	-0.6	-0.4	0.0	0.0	-0.4	0.0	-1.4
21-2, 21-3	0.0	-0.6	0.0	0.0	0.0	-0.1	0.0	-0.7
27-1	-1.2	0.0	-0.5	-0.1	-1.3	0.0	0.0	-3.1
29-1	0.0	0.0	-0.3	0.0	0.0	0.0	<0.1	-0.2
33-1	0.0	-0.2	0.0	0.0	0.0	0.0	0.0	-0.2
Total	-3.5	-3.6	-1.5	-0.2	-2.4	-1.6	1.0	-11.8

**Table 3: Alternative 3: Estimated Soil Disturbance**

Timber Sale Unit	Unit Area (Acres)	Soil Disturbance from Timber Harvest Activities (Acres)				Soil Disturbance from Road Construction and Decommissioning (Acres)				Total Disturbance
		Ground-based Com. Thin	Ground-based Regen.	Cable Yarding Com. Thin	Cable Yarding Regen.	New Perm. Road	Temp. Road (semi-perm)	Road Reconstruction	Additional Road Decom.	
3-1	103.8	0.0	9.5	0.0	0.3	0.0	0.5	1.6	2.4	14.3
7-1	50.6	0.0	0.0	1.0	0.0	0.0	1.6	0.0	0.0	2.6
9-1	13.1	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	1.3
15-1	53.2	1.5	3.9	0.0	0.0	0.0	0.7	0.0	0.7	6.8
21-1	76.1	0.0	4.1	0.7	0.0	0.0	1.1	0.0	0.0	5.9
21-2, 21-3	43.3	0.0	4.3	0.0	0.0	0.0	0.2	0.0	0.0	4.5
27-1	97.0	0.0	0.0	1.9	0.2	0.0	1.8	0.0	0.0	3.9
29-1	26.5	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.3	0.8
Total	463.6	1.5	23.1	4.1	0.5	0.0	5.9	1.6	3.4	40.1

**Table 4: Alternative 3: Estimated Acres of Loss in Soil Productivity**

Timber Sale Unit	Loss in Soil Productivity (Acres)						Increase in Soil Productivity (Acres)	Net Loss in Soil Productivity
	Ground-based Com. Thin	Ground-based Regen.	Cable Yarding Com. Thin	Cable Yarding Regen.	New Perm. Road	Temp. Road (semi-perm)	Decom. Reconst & Addit. Road	
3-1	0.0	-1.4	0.0	-0.1	0.0	-0.2	0.7	-1.0
7-1	0.0	0.0	-0.5	0.0	0.0	-0.6	0.0	-1.1
9-1	0.0	-0.2	0.0	0.0	0.0	0.0	0.0	-0.2
15-1	-0.4	-0.6	0.0	0.0	0.0	-0.3	0.2	-1.2
21-1	0.0	-0.6	-0.3	0.0	0.0	-0.4	0.0	-1.3
21-2, 21-3	0.0	-1.3	0.0	0.0	0.0	-0.1	0.0	-1.4
27-1	0.0	0.0	-1.0	-0.1	0.0	-0.6	0.0	-1.7
29-1	0.0	0.0	-0.3	0.0	0.0	0.0	0.1	-0.3
Total	-0.4	-4.1	-2.1	-0.2	0.0	-2.2	0.9	-8.1

**Table 5: Alternative 4, Alt 4/2: Estimated Soil Disturbance**

Timber Sale Unit	Unit Area (Acres)	Estimated Acres of Soil Disturbance (Acres)								
		Ground-based Com. Thin	Ground-based Regen.	Cable Yarding Com. Thin	Cable Yarding Regen.	New Perm. Road	Temp. Road (semi-perm)	Road Reconstruction	Additional Road Decom.	Total Disturbance
3-1, 3-2, 3-3	121.6	1.8	9.5	0.0	0.3	0.0	0.5	1.1	1.7	14.9
7-1	50.6	2.0	0.0	0.6	0.0	1.6	0.0	0.0	0.0	4.2
9-1	13.1	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	1.3
21-1	76.1	0.0	4.1	0.7	0.0	0.0	1.1	0.0	0.0	5.9
27-1	108.9	3.8	0.0	1.3	0.2	1.8	0.0	0.0	0.0	7.1
29-1	26.6	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.2	0.7
33-1	14.5	0.0	1.4	0.0	0.0	0.0	0.0	0.4	0.0	1.8
Total	411.4	7.6	16.3	3.1	0.5	3.4	1.6	1.7	1.9	35.9

**Table 6: Alternative 4, Alt 4/2: Estimated Loss in Soil Productivity**

Timber Sale Unit	Loss in Soil Productivity (Acres)						Increase in Productivity	Net Loss in Soil Productivity
	Ground-based Com. Thin	Ground-based Regen.	Cable Yard. Com. Thin	Cable Yard. Regen.	New Perm. Road	Temp. Road (semi-perm)		
3-1, 3-2, 3-3	-0.5	-1.4	0.0	-0.1	0.0	-0.7	0.7	-2.0
7-1	-0.6	0.0	-0.3	0.0	-1.1	0.0	0.0	-2.0
9-1	0.0	-0.2	0.0	0.0	0.0	0.0	0.0	-0.2
21-1	0.0	-0.6	-0.4	0.0	0.0	-0.4	0.0	-1.4
27-1	-1.2	0.0	-0.5	-0.1	-1.3	0.0	0.0	-3.1
29-1	0.0	0.0	-0.3	0.0	0.0	0.0	0.1	-0.2
33-1	0.0	-0.2	0.0	0.0	0.0	0.0	0.0	-0.2
Total	-2.3	-2.4	-1.5	-0.2	-2.4	-1.1	0.8	-9.1

**Table 7: Alternative 4, Alt 4/3: Estimated Soil Disturbance**

Timber Sale Unit	Unit Area (Acres)	Estimated Acres of Soil Disturbance (Acres)								
		Ground-based Com. Thin	Ground-based Regen.	Cable Yarding Com. Thin	Cable Yarding Regen.	New Perm. Road	Temp. Road (semi-perm)	Road Reconstruction	Additional Road Decom.	Total Disturbance
3-1	103.8	0.0	9.5	0.0	0.3	0.0	0.5	1.6	2.4	14.3
7-1	50.6	0.0	0.0	1.0	0.0	0.0	1.6	0.0	0.0	2.6
9-1	13.1	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	1.3
21-1	76.1	0.0	4.1	0.7	0.0	0.0	1.1	0.0	0.0	5.9
27-1	97.0	0.0	0.0	1.9	0.2	0.0	1.8	0.0	0.0	3.9
29-1	26.5	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.3	0.8
Total	367.1	0.0	14.9	4.1	0.5	0.0	5.0	1.6	2.7	28.8

**Table 6: Alternative 4, Alt 4/3: Estimated Loss in Soil Productivity**

Timber Sale Unit	Loss in Soil Productivity (Acres)						Increase in Produc- tivity	Net Loss in Soil Produc- tivity
	Ground- based Com. Thin	Ground- based Regen.	Cable Yard. Com. Thin	Cable Yard. Regen.	New Perm. Road	Temp. Road (semi- perm)		
3-1	0.0	-1.4	0.0	-0.1	0.0	-0.2	0.7	-1.0
7-1	-0.6	0.0	-0.3	0.0	-1.1	0.0	0.0	-2.0
9-1	0.0	-0.2	0.0	0.0	0.0	0.0	0.0	-0.2
21-1	0.0	-0.6	-0.4	0.0	0.0	-0.4	0.0	-1.4
27-1	0.0	0.0	-1.0	-0.1	0.0	-0.6	0.0	-1.7
29-1	0.0	0.0	-0.3	0.0	0.0	0.0	0.1	-0.2
Total	-0.6	-2.2	-2.0	-0.2	-1.1	-1.2	0.8	-6.5